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FREQUENCY OF DIFFERENTIATED SECTORED COLONIES AMONG BACTERIA IN SUSPENSION IN THE OUTSIDE AIR OBSERVED OVER THREE YEARS (ITS CORRELATION WITH VARIOUS PARAMETERS: WOLF'S NUMBERS, SOLAR FLUX, GEOMAGNETIC ACTIVITY, FLUCTUATING PHENOMENA)

P. Faraone

(NASA-TT-F-16202) FREQUENCY OF DIFFERENTIATED SECTORED COLONIES AMONG BACTERIA IN SUSPENSION IN THE OUTSIDE AIR OBSERVED OVER THREE YEARS (ITS CORRELATION WITH VARIOUS PARAMETERS: WOLF'S (Kanner
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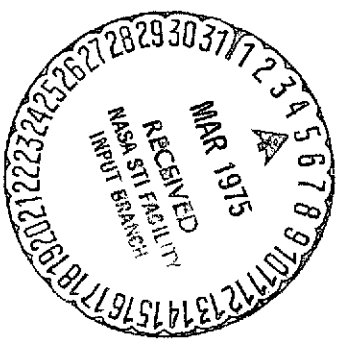

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16. Abstract

The frequency of differentiated sector colonies (C.S.D.) among bacteria in suspension in the outside air observed over three years.

The incidence of the colonies with differentiated sectors (C.S.D.) among the bacteria suspended in the external air during three years has been studied.

It seems probable tht the frequency may be connected with many astrophysical factors, as for instance the fluctuating phenomena.

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FREQUENCY OF DIFFERENTIATED SECTORED COLONIES AMONG BACTERIA IN SUSPENSION IN THE OUTSIDE AIR OBSERVED OVER THREE YEARS (ITS CORRELATION WITH VARIOUS PARAMETERS: WOLF'S NUMBER, SOLAR FLUX, GEOMAGNETIC ACTIVITY, FLUCTUATING PHENOMENA)

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I. Introduction and Purpose of This Investigation /207*

Certain American authors (Servin-Massieu, 1961 [9]) worked with sectored colonies and studied their spontaneous occurrence in laboratory cultures; they considered it to be a possible indication of genetic mutation.

Other authors related the phenotype of sectored colonies with the possibility that it may represent a genetic mutation in a certain bacterium (Witkin, 1951 [11]).

Sectored colonies (Servin-Massieu [9]) are colonies with a sector differentiated in some characteristics from the rest of the colony with which the sector has grown simultaneously until the end term of its development.

In this communication we report our studies on the frequency of sectored colonies, which we call C.S.D.[1] (colonie a settore differenziato), among bacteria in suspension in the outside air; we did not attempt to determine whether the phenotype represented by the C.S.D is the result of a genetic mutation.

We expressed the frequency of C.S.D. as a percentage of the number of colonies per plate (C.B.) of the bacteria isolated

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[1] [C.S.D. as used hereinafter will represent the phrase "sectored colonies."]

* Numbers in the margin indicate pagination in the foreign text.

from air, following its variations for three years (1970-1972).

This work is being continued.

In a previous communication (Faraone, 1971 [3]) we mentioned the possible importance of this fact in relation with astrophysical parameters. /208

At that time we mentioned Wolf's numbers but we did not draw any conclusions; we only expressed the hope to be able to study this phenomenon further and to seek a correlation with other parameters which might provide a more convincing inducement to pursue this investigation, and not only by the present author.

Materials and Methods.

We used the method of exposed plates, with plates of 90 mm. diameter, filled with agar tryptose from Difco; concurrently (since August 1970) we used the same medium, with addition of Actidione (100 µg/ml). This was done in order to always be able to take readings, even when molds may have invaded the plates without Actidone.

In these media the agar concentration was 20%.

The plates, (usually 10 with agar tryptose and 10 with agar tryptose and Actidione) were exposed to air on an appropriate grating located on a narrow metal platform, one meter above its floor, which was also a metal grating. This platform is located between two neighboring terraces, on a roof (astride its two sloping sides) about ten meters from the automatic station where our Institute collects meteorological data.

Samples were taken about 25-30 meters above street level in the absence of near obstacles preventing a wide view from the building.

The barometric pressure data were obtained from the

Brera Observatory in Milano. We will mention in the text what person or institute provided further data.

The exposure times varied from 5 to 120 minutes, and also the number of plates (which however was never less than 10 for sample taking), depending on the extent of pollution which depends, as the author has reported (Faraone, 1971 [3]) on many factors, such as the season, the wind, whether it rained recently, etc.

For establishing the frequency of the C.S.D. as a percentage of C.B. we related them to a number of colonies "assessed" to be sufficient, seldom less than 200-250 colonies with a total of about 300,000 colonies, studied in the course of 900 sample drawings.

After exposure, which usually took place in the afternoon, the media were incubated at 37°C for 2 days and for 4 more days at room temperature; readings were taken after this time.

We used strong magnifiers for reading the details of even the smallest colonies, with incident and transmitted light. We used a strong light source directed manually with a concave microscope mirror: through the magnifiers for incident light readings, and behind and through the transparent support of the plate for transmitted light readings. In special cases we used also a microscope, under low power (50 x). The criterion for the choice of the C.S.D. was at the same time simple and complicated, according to how sharp the difference was between the sector and the rest of the colony.

A yellow or opaque sector on a white, or smooth and shiny colony, is considered sharp; some minimal and transparent sectors could be visualized only after having acquired some experience with a certain colony, even if there is some difference. Much depends on the angle of the light rays. We

discarded the doubtful cases (often due to superposition of neighboring colonies or to relatively large foreign bodies).

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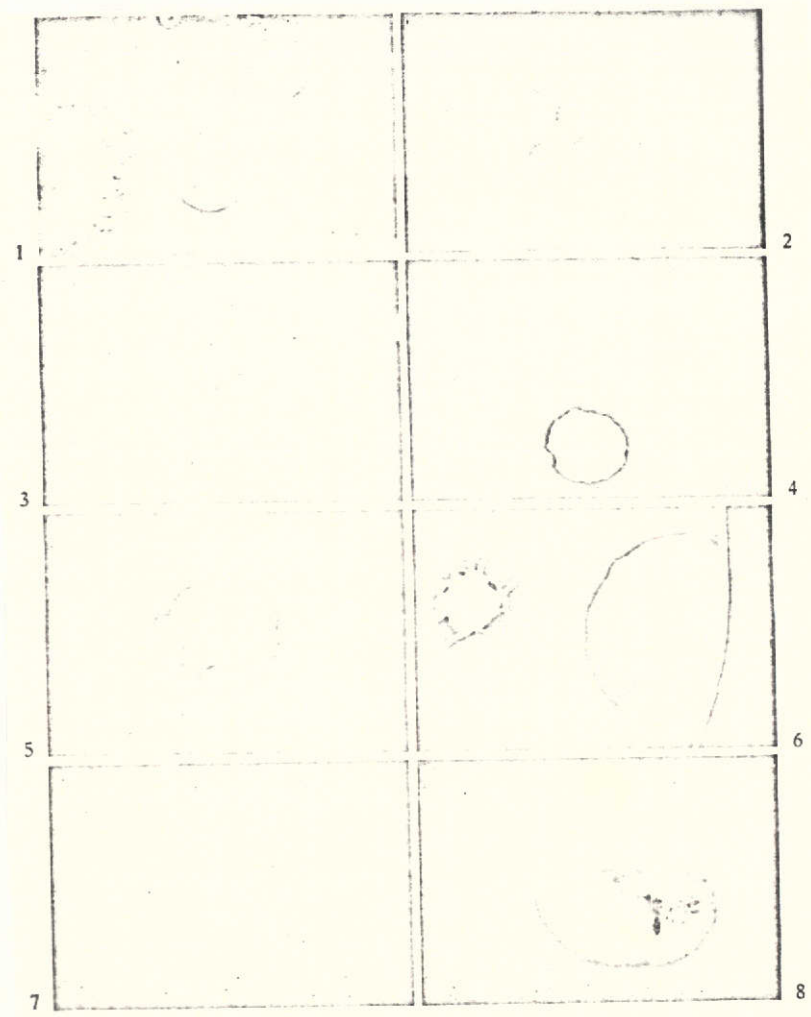

Fig. 1-C.S.D.: chromogen (center colony)
Fig. 2-C.S.D.: sporigen
Fig. 3-C.S.D.: sporigen
Fig. 4-C.S.D.: Micrococcacea (bottom colony)
Fig. 5-C.S.D.: chromogen
Fig. 6-C.S.D.: sporigen (colony at edge of plate)
Fig. 7-C.S.D.: sporigen
Fig. 8-C.S.D.: mycete (relatively rare)

Concerning the light source used in the reading of the C.S.D. we experimented with a microbulb of 3 mm diameter, mounted on a thin metal tube of 5 mm diameter, bent at a right angle and with its horizontal part about 5 cm long. This system avoids dazzling the observer during the observations and takes care of the detail being studied in a more limited field, always with the aid of magnifiers. We also used a normal biconvex lens, on which a plane-convex lens was superimposed, the latter being cut in such a manner as to be able to put the bulb in the missing part (about 1/4 of the upper lens); this permits a sharper reading under incident light; this also permits a quick and easy choice of using one or both the superimposed lenses. /209

For the transmitted light readings, with the bulb behind the plate, we recommend keeping it parallel to the plate's plane, moving slowly behind the detail to be studied, varying the angle slightly, and repeating this several times.

Results

Table I contains the data collected daily and expressed as average values for ten-day periods.

Table II contains the same data as Table I, as averages in groups of six (bimonthly values) using the sliding (or rotating) averages method, i.e. the average of the 1st, 2nd, 3rd, 4th, 5th, 6th; then that of the 2nd, 3rd, 4th, 5th, 6th, 7th, and so on until all ten-day data have been utilized. Whenever these were missing (see two of them in October 1972), we obtained their value in a cartesian coordinate system, on the line joining the values immediately before and after them.

Figure 9 contains several curves with common abscissa values i.e. the observation time, and with the values of the rotating averages given in Table II as the ordinates.

Figure 10 gives as ordinate the average values of C.S.D.

for ten-day periods (not including mycetes)[2]; this was done over several years: from February 1970 to March 1973.

Figure 11 reports a series of daily data based on those of August 1972. C.S.D. values are expressed here as was done in Figure 10: it is however pointed out that in that period there were three consecutive days of intense sun glare (2, 4, and 7 August), as was noted by many astrophysical laboratories around the world [1]. /217

TABLE I. ALL THE NUMERICAL VALUES ARE AVERAGES, COMPUTED FOR TEN-DAY PERIODS.

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	1970											
	January			February			March			January		
C.S.D.	—	—	—	3.47	2.03	2.22	2.25	5.16	9.89	3.72	6.25	4.5
N.W.	67.8	147.5	118.3	99.4	138.1	150.2	117.0	70.3	119.6	62.1	76.2	86.6
F.S.	128.8	173.4	156.9	138.0	196.0	181.6	168.2	144.2	157.6	143.7	156.2	170.5
A.G.	8.8	7.5	5.8	7.4	6.1	6.9	35.1	5.0	12.8	9.5	10.4	16.1
F.F.	59.4	71.1	74.6	56.7	30.6	33.0	30.8	32.6	41.3	61.0	59.6	48.8
P.A.	747.0	746.7	752.6	747.1	747.2	747.7	745.2	748.8	749.2	755.0	752.7	747.2
	April			May			June			April		
C.S.D.	7.43	4.37	7.21	11.14	9.06	6.99	—	—	—	3.96	3.43	4.5
N.W.	131.9	109.1	87.4	109.1	153.7	120.3	70.8	138.6	111.2	56.7	99.0	56.3
F.S.	187.3	163.6	138.1	161.4	193.1	162.8	136.8	186.7	156.0	108.2	136.6	107.8
A.G.	10.8	12.9	23.1	7.0	8.7	11.4	9.8	11.5	10.3	18.2	16.6	10.1
F.F.	37.1	59.4	46.3	46.7	55.9	36.3	38.8	36.4	26.3	45.5	45.8	51.5
P.A.	743.9	752.2	751.0	750.3	749.7	751.9	752.2	749.5	752.4	745.0	752.7	749.2
	July			August			September			July		
C.S.D.	8.56	6.32	11.73	17.56	11.21	10.48	7.38	5.69	12.96	4.63	5.45	3.3
N.W.	136.4	72.3	127.2	70.2	97.9	109.2	116.0	80.2	102.2	79.8	75.3	89.3
F.S.	175.4	130.2	164.4	130.9	150.7	143.1	158.3	125.8	149.6	126.6	118.2	111.9
A.G.	23.8	7.8	34.9	9.3	22.5	8.9	10.5	11.9	10.1	7.3	6.6	10.3
F.F.	19.1	21.4	21.8	26.1	63.6	71.4	31.6	22.8	47.1	53.6	46.0	51.6
P.A.	750.2	748.4	751.4	749.7	749.4	750.5	751.5	751.9	755.6	751.2	749.5	750.8
	October			November			December			October		
C.S.D.	11.57	9.99	9.14	10.07	13.25	12.46	7.23	3.37	4.10	3.69	5.23	3.3
N.W.	65.1	82.0	110.3	79.2	119.6	86.8	89.8	89.8	72.0	47.2	37.2	0.8
F.S.	134.7	136.5	168.3	150.2	181.6	143.5	160.2	157.7	128.0	105.1	96.8	1.6.3
A.G.	8.8	18.0	10.3	13.3	10.0	12.3	6.6	11.7	8.3	19.5	6.5	9.8
F.F.	62.3	62.3	83.3	59.5	49.0	46.8	56.7	50.3	51.9	47.5	52.1	46.0
P.A.	750.8	754.4	756.2	753.6	748.8	754.3	758.1	760.0	746.3	756.8	754.6	753.3

[Table 1 continued]

[2] C.S.D. are rare among mycetes (Faraone, 1971 [3]).

1971						1972					
February			March			January			February			March		
3.98	2.14	1.88	1,33	4.02	3.47	3,66	4,32	4,21	7,50	1,88	4,09	5,41	3,35	2,98
65.0	67,8	84.3	58.0	65,9	51.3	49,0	45,4	105,8	50,2	113,0	102,3	79,9	101,0	72,2
139.4	123,2	162.3	113.6	111.9	107.1	99,2	109,2	123,5	104,9	155,0	157,2	136,2	132,2	114,2
7.9	13.0	15.7	8.0	17.5	8.9	5,9	13,4	17,8	7,9	12,9	9,5	14,3	8,3	14,0
46.8	44,1	43.1	46.5	41.1	43,0	48,5	47,3	39,1	44,8	51,8	44,0	51,5	50,3	51,9
735.7	747,1	751.0	751.7	748.4	745.7	753,9	749,5	747,3	750,8	745,6	750,9	745,1	754,4	749,3
May			June			August			May			June		
7.65	6.91	7.54	6.73	5.22	5.20	6.56	6.94	5.63	6.35	6.99	4.80	—	—	—
61.9	61,3	40.6	40.8	31.4	69,0	56.3	66.6	69.9	57.4	114.7	68.8	95.3	76.2	78.6
118.5	118.6	100.0	104.6	93.6	106,3	112.1	122.4	106.4	113.7	158.4	126.0	146.0	143.4	129.5
17.0	17.0	7.0	11.5	5.5	11.1	9.6	9.5	13.6	9.3	11.4	9.0	7.7	25.6	10.2
59.8	59,3	56.5	67.8	64.1	59.3	42.5	38.8	41.8	46.1	45.8	68.7	67.6	55.9	66.9
75.3	751.0	745.5	746.2	749.1	747.9	748.5	742.5	745.2	746.9	746.3	751.5	749.8	747.9	748.4
August			September			July			August			September		
5.70	6.00	5.36	3.65	2.68	3.59	4,44	7,57	8,26	8,34	12.50	11,19	9,01	6,33	7,11
54.2	59.2	65.8	39.8	53.3	49,5	83,6	68.1	83.6	76.3	47.9	97.1	74.2	39,0	70,8
107.6	108.6	132.7	96.3	107.0	111.9	138,1	115.8	124.2	139.6	106.8	139,0	121.8	102,6	102,2
3.6	8.1	9.6	9.7	14.5	14.2	6,3	5.9	10,7	54.1	10.2	9.6	7.4	21.6	9.7
57.3	53.0	51.2	43.8	38.6	47.3	64.5	59,5	59.2	51.6	49.4	47.3	45.2	52.2	53.8
749.7	750.1	749.0	752.8	752.7	752.4	749.6	749,2	748.1	749.9	748.8	750.2	750.5	750.1	751.9
November			December			October			November			December		
7.66	5.83	5.99	6.56	2.84	2.99	7.30	7.50	7.91	6.66	7.28	12.41	7.54	5.63	5.15
57.6	40.4	83.5	85.3	108.8	78.0	—	—	—	—	—	—	—	—	—
118.4	104.9	121.1	113.7	125.3	122.6	—	—	—	—	—	—	—	—	—
5.0	5.4	21.3	5.3	14.5	10.1	4.9	16.8	14.5	19.4	12.8	9.6	—	—	—
34.0	43.6	35.8	41.0	56.3	49.3	46.8	51.0	58.8	—	—	—	—	—	—
751.9	747.5	744.4	753.3	758.8	756.4	753.3	751.1	751.8	756.9	747.9	753.2	753.2	760.9	760.3

C.S.D. = Differentiated sector colonies; their frequency is indicated as the total bacterial percent, expressed as the number of the colonies studied, minus that of mycetes. [Translator's note: the right edge of the copy is missing. This is the translator's best guess.]

N.W. = Wolf's numbers (provisional data); these express the solar activity, through the number of solar spots [8].

F.S. = Solar flux; this also expresses solar activity [2].

(Key continued on next page)

[Key to Table 1, continued]

A.G. = Earth's geomagnetic activity, expressed in its variations (oscillations of the earth's magnetic field) [5].

F.F. = Fluctuating phenomena (Test P); colloidal precipitation phenomena, run simultaneously inside and outside a screened chamber. The values express the percent of cases in which precipitation was faster under screening [4].

P.A. = Atmospheric pressure; barometric pressure adjusted to 0°C (Brera Meteorological Observatory, Milan).

NOTES: The following data should be added for C.S.D.: January 1973: 7.78 - 10.54 -8.68; February: 7.92 - 5.69 - 5.93; March: 4.67 - 3.65 - 5.29.

TABLE II. THE AVERAGE VALUES FOR TEN-DAY PERIODS ARE EXPRESSED HERE BY THE METHOD OF SLIDING (ROTATING) AVERAGES

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	1970											
	January			February			March			January		
C.S.D.	—	—	—	4,17	4,83	5,22	6,05	7,53	8,18	3,75	3,35	2,9
N.W.	120,2	128,4	115,5	115,7	121,2	116,3	105,9	104,5	118,4	73,7	73,0	71,3
F.S.	162,4	169,0	164,1	164,2	172,5	167,1	159,8	158,7	166,8	149,2	144,2	136,8
A.G.	7,1	11,4	11,0	12,2	12,8	13,9	16,6	11,9	12,5	12,2	11,9	3,1
F.F.	54,2	49,6	43,0	37,5	34,2	39,0	41,2	43,9	47,8	50,5	48,1	45,0
P.A.	748,0	747,7	748,1	747,5	747,0	747,8	748,4	749,2	749,4	751,4	750,9	750,2
	April			May			June			April		
C.S.D.	7,70	—	—	—	—	—	—	—	—	5,66	6,12	6,4
N.W.	118,6	108,4	113,3	117,3	121,8	108,2	109,4	109,3	102,5	62,5	59,8	43,6
F.S.	167,7	159,3	163,1	166,1	168,4	157,9	158,2	157,2	151,2	115,1	114,5	107,3
A.G.	12,3	12,1	11,9	9,8	12,6	12,4	14,7	14,6	16,4	14,3	13,2	11,3
F.F.	46,9	47,2	43,4	40,0	35,4	29,7	27,3	25,2	29,7	52,2	55,9	53,0
P.A.	749,8	751,2	750,8	751,0	751,0	750,7	750,7	750,2	750,2	749,1	749,3	749,7
	June			August			September			July		
C.S.D.	10,97	10,78	10,67	10,88	9,88	9,68	9,45	9,90	11,16	5,30	5,13	4,6
N.W.	102,2	98,8	100,1	95,9	95,1	92,4	92,6	86,5	93,0	70,6	63,9	61,2
F.S.	149,1	146,2	145,5	143,0	143,7	141,3	145,5	144,2	153,5	117,6	112,5	110,7
A.G.	16,2	13,9	14,6	12,2	12,1	11,3	11,6	12,0	11,7	8,2	8,6	9,9
F.F.	37,2	39,3	39,5	43,7	49,8	49,6	51,5	56,2	60,6	52,1	50,5	49,2
P.A.	749,9	750,1	750,7	751,4	751,6	752,4	753,4	753,7	753,2	750,0	750,3	750,8
	October			November			December			October		
C.S.D.	11,03	10,35	9,25	8,41	7,35	6,19	4,86	4,32	4,12	5,29	5,77	5,3
N.W.	90,5	94,6	95,6	89,5	86,7	79,4	79,4	75,3	71,6	56,0	62,4	74,3
F.S.	152,4	156,7	160,2	153,5	152,4	148,2	152,7	149,3	143,5	108,7	110,2	114,9
A.G.	12,1	11,7	10,7	10,3	9,7	9,8	10,5	10,7	10,9	11,2	8,9	10,2
F.F.	60,5	59,6	57,6	52,3	52,6	54,4	54,7	53,0	52,0	46,5	45,4	46,1
P.A.	753,0	754,2	755,2	753,5	755,4	754,4	753,2	752,8	750,7	752,2	751,6	752,3

[TABLE II continued] /213

1971						1972								
February			March			January			February			March		
2,30	2,80	3,01	3,45	4,50	4,98	4,27	4,57	4,40	4,20	4,04	4,89	5,14	5,30	5,90
65,4	64,0	69,2	64,5	65,0	64,3	77,6	82,7	92,0	86,4	87,4	79,7	74,3	70,5	72,8
126,2	121,0	123,2	114,1	115,1	116,2	124,8	131,0	134,8	133,3	134,5	129,0	120,6	116,8	121,2
11,8	13,5	14,1	13,2	14,7	14,6	11,2	12,6	11,8	11,1	11,4	10,8	11,5	10,7	11,2
44,1	43,9	44,1	45,6	46,9	50,0	45,9	46,4	46,9	49,0	48,6	46,5	46,1	45,2	44,5
749,9	748,1	749,1	748,8	748,7	749,1	749,6	748,2	749,0	749,3	748,9	748,4	747,5	747,8	746,4
May			June			April			May			June		
6,54	6,04	5,79	5,15	5,14	5,27	6,21	—	—	—	—	—	—	—	—
50,5	53,8	56,1	64,2	66,5	71,1	72,3	78,8	80,4	8,18	86,2	78,4	80,9	77,7	73,0
108,7	109,9	109,9	111,8	112,3	114,8	123,1	128,8	132,3	136,1	140,2	133,1	132,8	131,7	125,6
11,5	9,9	8,1	8,5	8,0	8,4	10,4	10,1	12,7	12,2	11,7	10,8	11,0	18,8	16,2
60,3	60,1	57,9	57,0	55,3	53,4	47,3	51,4	54,3	58,5	61,5	63,8	62,2	59,6	58,5
748,5	748,5	748,2	749,1	749,7	749,8	746,8	747,0	747,9	748,4	748,9	749,4	748,8	748,8	749,0
August			September			July			August			September		
4,66	4,16	4,03	3,70	4,37	4,89	8,71	9,48	9,27	9,08	8,91	8,07	7,53	7,13	7,29
53,6	52,4	48,8	49,5	52,5	50,4	76,1	74,5	69,7	67,5	—	—	—	—	—
110,7	110,2	108,3	105,5	107,6	107,2	127,2	124,5	122,3	121,6	—	—	—	—	—
10,8	12,6	12,3	12,3	11,6	10,0	16,1	16,3	18,9	18,7	10,5	11,6	12,5	14,5	13,0
48,5	46,9	46,7	45,8	47,6	48,4	55,2	52,0	50,8	49,9	49,1	49,4	51,3	—	—
753,3	752,4	753,2	754,7	754,6	753,7	749,3	749,4	749,6	750,2	750,8	751,2	751,4	752,5	752,1
November			December			October			November			December		
4,31	4,64	4,39	4,09	4,25	4,09	8,18	8,22	7,90	7,44	7,63	8,17	7,55	7,62	7,62
73,6	74,1	75,0	78,7	72,8	73,5	—	—	—	—	—	—	—	—	—
115,0	114,4	115,2	115,6	114,1	119,0	—	—	—	—	—	—	—	—	—
11,2	10,4	11,7	11,1	11,6	11,3	13,0	—	—	—	—	—	—	—	—
45,6	45,7	46,3	46,9	47,5	46,8	—	—	—	—	—	—	—	—	—
751,0	752,3	752,7	753,2	752,8	750,6	752,3	752,3	753,9	755,4	—	—	—	—	—

NOTE: The following data should be added for C.S.D: 7.76 - 7.24 - 6.09 and 5.52 successively.

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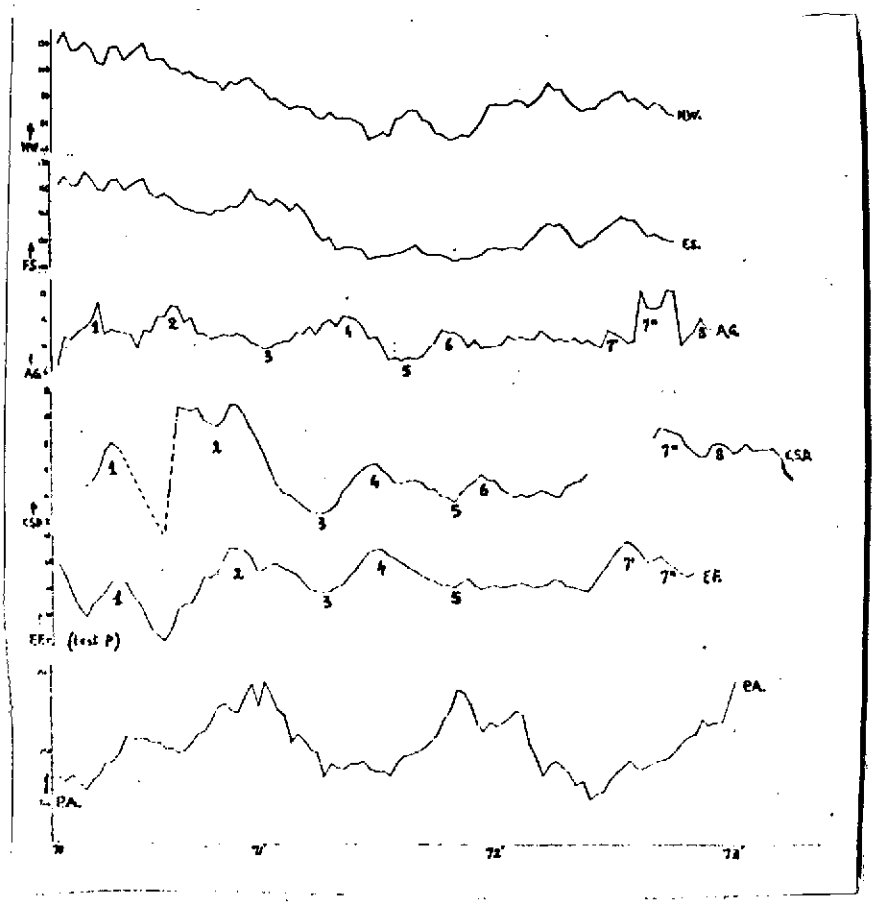

Figure 9. The chart expresses the numerical values reported in Table II. The dotted line (1970) has been compiled theoretically.

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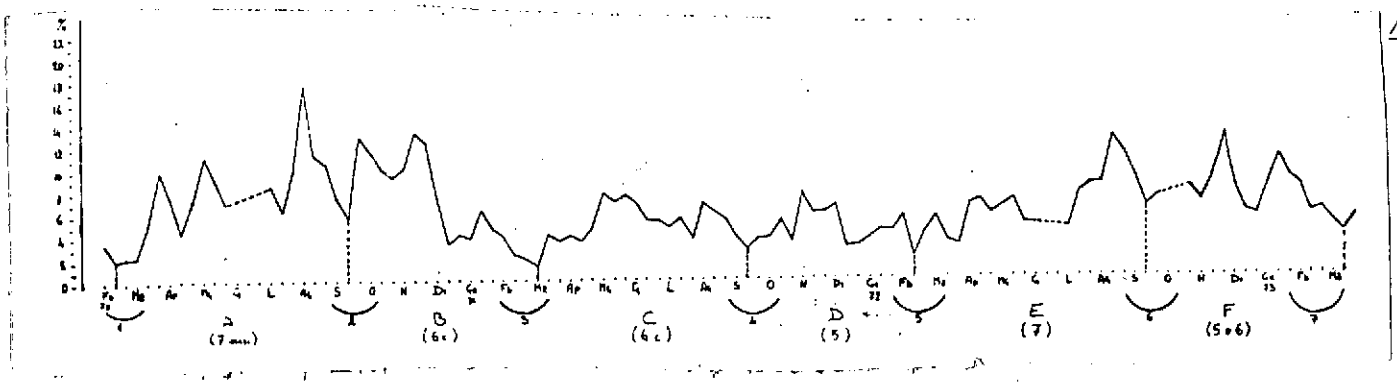

Figure. 10. The graph expresses the 10-day values reported in Table I.

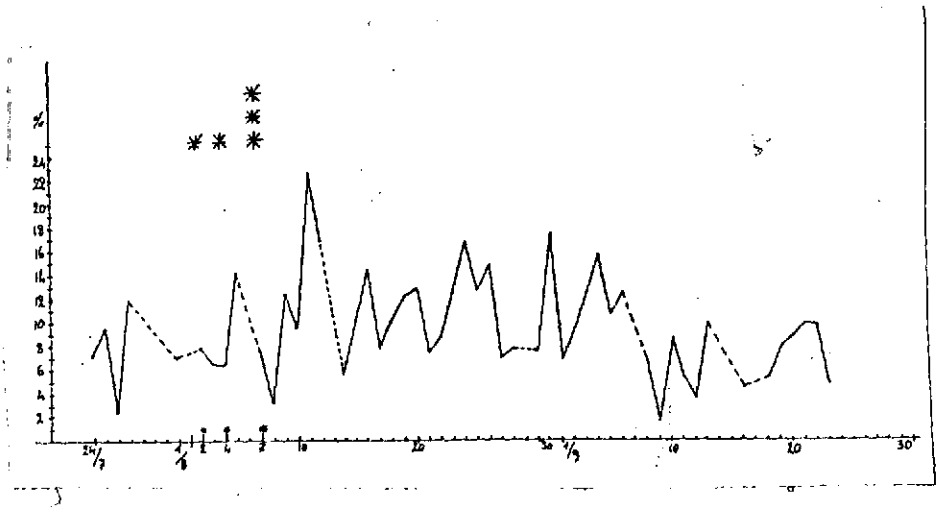

Figure 11. Ordinate: indicates the various frequencies of C.S.D., expressed as percentages of C.B. (number of colonies per plate), after subtraction of the number of colonies of mycetes.

Abscissa: indicates the day when samples were taken.

NOTE: The asterisks indicate the days when strong sunglares occurred; the strongest glare is indicated with three asterisks. Following is a list of the data plotted (ordinate) daily.

24	July	1972	= 7,02%	14	August	1972	= 5,59%	1	Septem.	1972	= 6,82%
25	»	»	= 9,34%	15	»	»	= 10,00%	2	»	»	= 9,40%
26	»	»	= 2,30%	16	»	»	= 14,30%	4	»	»	= 15,70%
27	»	»	= 11,85%	17	»	»	= 7,93%	5	»	»	= 10,50%
31	»	»	= 7,04%	18	»	»	= 10,07%	6	»	»	= 12,44%
2	August	1972	= 7,86%	19	»	»	= 12,01%	8	»	»	= 6,71%
3	»	»	= 6,50%	20	»	»	= 12,80%	9	»	»	= 1,68%
4	»	»	= 6,32%	21	»	»	= 7,38%	10	»	»	= 8,88%
5	»	»	= 14,10%	22	»	»	= 8,71%	11	»	»	= 5,26%
7	»	»	= 7,39%	23	»	»	= 12,43%	12	»	»	= 3,49%
8	»	»	= 3,01%	24	»	»	= 16,86%	13	»	»	= 9,91%
9	»	»	= 12,22%	25	»	»	= 12,50%	16	»	»	= 4,34%
10	»	»	= 9,31%	26	»	»	= 14,89%	18	»	»	= 5,08%
11	»	»	= 22,83%	27	»	»	= 6,94%	19	»	»	= 7,72%
12	»	»	= 16,98%	28	»	»	= 7,68%	20	»	»	= 8,50%
				30	»	»	= 7,27%	21	»	»	= 9,74%
				31	»	»	= 17,25%	22	»	»	= 9,71%
								23	»	»	= 4,51%

Discussion

In Figure 9, various parameters are represented in cartesian coordinates; comparison of the A.G., C.S.D., and F.F. curves shows more or less obvious, but undisputed, concordances (these are indicated by the same figures). However, while the C.S.D. and F.F. curves have concordances which are simultaneous in time, the A.G. shows some advance over the other two curves; it should be emphasized that stretch 6 of the A.G. curve corresponds to stretch 6 of the C.S.D. curve, but that curve F.F. has no corresponding stretch. It is also interesting to note that in 1970 and part of 1971, as many as four curves show doubtless concordances with each other: A.G., C.S.D., F.F., and P.A.

The N.W. and F.S. curves, the first connected with the solar spots, and the second with the solar flux, have a resemblance only to each other.

Figure 10 shows a curve expressing several periodicities. Three of them are more extended: A-B (from 1 to 3), C-D (from 3 to 5), D-F (from 5 to 7); for these it is observed that the intensity of the phenomenon follows the following pattern: A-B > C-D < D-F (i.e. a more intense period is followed by a less intense one, which in turn is followed by a more intense one).

In continuing this research it will be very interesting to observe whether this rhythmic behavior is correlated with a rhythmicity of other parameters - such as the intensity of solar radiations (see Conclusions) or of cosmic radiations (neutrons) on earth - and perhaps in a negative sense; i.e. a higher curve A-B may periodically be opposed to a descending curve of cosmic activity, and, the C-D curve, which shows a lesser intensity of the C.S.D phenomenon, may be opposed to one expressing a higher cosmic activity, and so on alternately. Some preliminary investigations seem to

indicate that this may be the case.

It will however be necessary to have more time and more data before making a hypothesis.

Finally, in general in the curve we note four minimum periods of intensity which reoccur at the same time of the year in successive years, i.e. in February-March (see in the Figure 10 the periods marked 1, 3, 5, 7). Might this be explained by the solar hypothesis of the late Professor Piccardi?[3] /218

In addition the various portions of the curve marked with the letters from A to F and whose boundaries are fixed by the areas numbered from 1 to 7 (A between 1 and 2, etc.) have a certain analogy. Indeed they are all between periods of lower intensity of the C.S.D. phenomenon; in addition to those that we call the main ones, (1-3 - 5-7), there are also secondary ones (2-4-6; September); these are thus less intense periods relative to those of the closest ten-day periods.

Also in this case it is useful to be reminded that Piccardi on the subject of the test for studying fluctuating phenomena (F.F.) has admitted the existence of secondary periods of lower activity which repeat themselves in August at a regular

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[3] Piccardi [6]: The earth follows in its own galaxy a helicoidal orbit by combining its own circular motion around the sun with the straight uniform motion towards the Hercules constellation, together with the sun. It follows that: in March the earth moves along its equatorial plan at a linear velocity (relative to the galaxy) reaching its maximum; in September the earth changes its position (of its magnetic dipole) and moves almost along its own axis, with the North pole in front; in this period its linear velocity is minimum: in outer space there are clouds of ionized matter and various magnetic fields are generated in it. For the earth moving in this space, now in one direction now in another, this fact means that there is a continuous change of conditions which will also be subject to a certain periodicity during the course of the year.

rhythm (i.e. approximately in September), in addition to a period of minimum intensity of the F.F., in February-March.

Finally let us consider the remarkable resemblance of the portions C and D of the curve which emphasize the fact that the portions A to F have interesting analogies with each other, which are more or less evident depending on the intensity.

Finally, Figure 11 is not reported merely as an oddity. It is seen in this figure that three days after a series of sunbursts had taken place, the third one of which was particularly intense (August 7, 1972) [1], a strong ascent of the C.S.D. curve followed after a few days delay (days 9 to 12 included).

In addition, (Table I and Figure 10) the C.S.D. value of the corresponding ten-day period, and of the following ten-day periods, have recorded values considerably higher than those of the immediately preceeding and following ten-day periods. At least in that occasion, this may lead to consideration of the influence of the increased solar activity.

The sunbursts do indeed correspond to a period of increased solar activity lasting for several days and affecting the earth's magnetic field.

It is important that the A.G. in the first ten days of /219
August 1972 reached very high values (Table I), the highest in the three-year period considered here. It would be useful to document other similar examples with astrophysical data (Fig. 11).

Before concluding, it will be useful to give some details of fluctuating phenomena (F.F.) studied by Piccardi; until recently they have been observed at the University of Florence, and reported in the journal "Coelum", published by the University of Bologna.

It has been proposed to study the F.F. using three tests of colloidal precipitation of bismuth oxichloride, called D, F, and P. Before discussing them, it should be emphasized that science has now shown the existence of many variable factors capable of exerting an influence on systems with a sensitive structure, such as the colloidal phenomena; Piccardi [7] reported an interesting proposition: "Heterogeneous and non-equilibrium systems, when they are sufficiently complex, respond to any external signal, even if the energy of such signal is extremely small."

Variable factors in the surrounding space are: gravitational, electric, magnetic, electromagnetic fields, solar activity, cosmic radiation. It is known that protoplasm is the seat of a chain of processes which are at the base of life; it does readily react to external stimuli.

There are in protoplasm, in a heterogeneous mixture, crystals of different molecules, with different electric charges arranged according to a precise architecture, so as to allow life in its functional expression as prearranged by the genes or factors which, through reproduction, assure the conservation of its properties.

Protoplasms react to a force either by undergoing its effect in a temporary manner and then going back to the original state (reversibility; increase of melanin in epidermis cells, by action of U.V. radiation), or by undergoing a permanent genotypic transformation (mutation), or by being destroyed.

A radiation energy (U.V.), a corpuscular energy (alpha, beta rays, etc.) may hit a cell and cause one of the effects mentioned above.

An electromagnetic force might cause the substrate, the protoplasm's architecture, to "resonate", causing one of the above-mentioned effects.

This means that a structure may be disrupted by a powerful striking force, but that same structure may "vibrate" in the same manner as a tuning fork vibrates due to another tuning fork, if it enters into resonance with it; a rhythmic series of weak forces, repeated "in resonance" with the cytoplasm's structure, causes vibrations which go on adding to each other and the oscillation might become sufficiently intense to modify the cytoplasm's structure. /220

Electromagnetic waves appear to have a basic rôle as causes of resonance of protoplasms: by putting their molecules in motion, they would make it possible for life itself to occur.

At this point it is useful to explain what the three tests D, F, and P are:

Test D: precipitation of bismuth oxichloride carried out in duplicate, one set with activated water, the other with normal water, but in both cases the interior of the chamber is entirely lined with thin copper.

Test F: as above, but outside the screening chamber; this is in order to see whether the screening causes differences in the precipitation phenomena: by protecting the colloidal system, for example, from any possible electromagnetic actions. According to Piccardi, thus, if the colloidal system responded differently outside (F) and inside (D) the screened chamber, it was possible to assume that the colloidal system might have responded to external actions.

In both cases the advance (T) or the delay (R) of the colloidal precipitation in activated water as compared with normal water is calculated as a percentage; any differences in the phenomenon according to whether it is calculated F or D, or any possible analogies between F and D are observed.

We have thus seen that T, both in F and in D, has: a secular variation, perhaps correlated with that of the solar activity (decrease during 1951, 1952, 1953 and part of 1954 followed by a strong increase), an annual variation especially evident in D where deep minima are seen; this may be related to the motion of the earth around the sun, short variations, of minor extent, probably correlated with the various external phenomena.

Finally T in F shows a different course from that in D, and sometimes opposite to it (Piccardi [6]; Trezzi [10]).

According to Piccardi, Becker has shown that in F there are short variations related to solar eruptions, while Burkard seems to have noted an effect of magnetic storms.

Concerning T in D, Piccardi [6] reported that there is an annual variation with a very deep minimum corresponding to the month of August; he further states that in long periods a parallelism has been observed between the course of the curve of these tests and that of the curve of cosmic radiations (he does not specify which ones), recorded by Steinmaurer at Hefelakar near Innsbruck. The annual variation of /221
T on F on the other hand has a maximum in the winter and a minimum in the summer.

Test P: carried out the same colloidal precipitation, but always in normal water, inside and outside the metal screen. When such precipitation occurs more rapidly under the screen, this is expressed as a percent. The wide variations given by the test would show that the conditions of space vary strongly in time (e.g. conditions connected with electromagnetic phenomena); indeed, in experiments made with the P test at various distances from a 10 W generator of persistent waves (Trezzi [10]) emitting at 10 KHZ, it was observed that the electromagnetic field had a delaying effect (the delay was greater at two meters than at twenty meters). The possibility

of affecting a colloidal system in this manner may be of importance for biological systems: these have an extraordinary common component: H_2O.

I should like to quote in its entirety the "colorful image" published recently in a popular scientific magazine: "According to the latest hypothesis, water, even at a temperature of 38°C, has a particular structure in which its molecules are associated in complexes of five pyramids with a triangular base. These geometric shapes in which all the molecules constituting the individuals are located, rotate, oscillate, jump, and are deformed by the effect of forces coming from cosmic space and produce the waves which keep the molecular networks in the cytoplasm moving, by providing them continuously with fresh energy!"

It is an imaginative picture, but it refers to a reality which is now better and better understood; in this sense Piccardi is especially meritorous.

In this work we have reported experiments that we have performed, we have collected data, compared them, raised questions, suggested ideas, hypotheses; briefly, also in this occasion we seek a resonance effect so that others may better carry out what has so far only been sketched.

Conclusions

From three years of research it would appear that the frequency of the C.S.D. in outside air is not dependent on chance. It appears to be related to astrophysical phenomena which, as we attempted to state in the past, also involve colloidal systems. The whole picture has a certain regularity concerning its development in time; there is a certain regularity of cadence, and a periodicity of varying amplitude, which can thus be expressed in terms of varying times and /222
which repeat themselves with these characteristics (see for

example the yearly minima in the February-March arc, which have repeated themselves already for four consecutive years). One can guess a yearly variation (70 with higher C.S.D. frequency, 71 with lower, 72 with higher) which appears to follow a regular oscillation; however three years are still insufficient to make further statements (however it is perhaps possible to anticipate a certain correlation with the solar acitvity expressed in curves N.W. and F.S.) (Fig. 9).

We have noted a concordance between the C.S.D. curve and the F.F. curve (Test P), this for times shorter than one year; among other things, according to what we said above, this suggests that also the C.S.D.'s might be conditioned in their frequency by artificial, as well as natural, sources of electromegnetic waves, even though these, as we have seen, have a limited range in the surrounding space. It has been found that in closed quarters the C.S.D. have a different frequency from the one that they have outside.

This should be studied in more detail. It is apparent that samples should be taken outside, always in the same place, and preferably away from possible interferences as indicated above. On this account, matters are not clear at all.

In this work we always took samples in the same place and usually in the afternoon hours. There may have been interferences, but it is not possible to say what kind. The results are however more than encouraging, I should like to say they are tangible. In addition the concordance of the C.S.D. curve with the A.G. curve suggests that if the C.S.D.'s frequency may have suffered various influences, the one of the geomagnetic activity is evident; it might also be that C.S.D. and A.G. are affected in their turn by a common cause that conditions them in time.

Further work and observations will clarify the matter

that has been submitted to the attention of whomever will do further work.

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